

CLAIMS

1. A branching filter comprising a transmitting filter and a receiving filter wherein piezoelectric thin film resonators including at least one piezoelectric thin film sandwiched between at least one pair of facing electrodes are disposed in a ladder type on an opening or a recess of a substrate, the transmitting filter and the receiving filter being connected to an antenna terminal in parallel, and wherein the piezoelectric thin film resonators forming the transmitting filter and the piezoelectric thin film resonators forming the receiving filter comprise a different structure.
2. The branching filter according to claim 1, wherein the piezoelectric thin film resonators forming the transmitting filter and the piezoelectric thin film resonators forming the receiving filter comprise a different piezoelectric film.
3. The branching filter according to claim 2, wherein the piezoelectric film of the piezoelectric thin film resonators forming the transmitting filter comprises AlN and the piezoelectric film of the piezoelectric thin film resonators forming the receiving filter comprises ZnO.
4. The branching filter according to claim 1, wherein the material of the electrodes is different between the piezoelectric thin film resonators forming the transmitting

filter and the piezoelectric thin film resonators forming the receiving filter.

5. The branching filter according to claim 4, wherein the acoustic impedance of the material of the electrodes is different between the piezoelectric thin film resonators forming the transmitting filter and the piezoelectric thin film resonators forming the receiving filter.

6. The branching filter according to claim 4, wherein the frequency of the pass band of the receiving filter is higher than the frequency of the pass band of the transmitting filter, and the acoustic impedance of the material of the electrodes forming the receiving filter is higher than the acoustic impedance of the material of the electrodes forming the transmitting filter.

7. The branching filter according to claim 1, wherein the piezoelectric thin film resonators forming the transmitting filter use second harmonic waves and the piezoelectric thin film resonators forming the receiving filter use fundamental waves.

8. The branching filter according to claim 1, wherein the piezoelectric thin film resonators forming the transmitting filter and the piezoelectric thin film resonators forming the receiving filter further comprise a different insulating film on the opening or the recess of the substrate.

9. The branching filter according to claim 8, wherein the

insulating film of the piezoelectric thin film resonators forming the receiving filter comprises  $\text{SiO}_2$ .

10. The branching filter according to claim 8, wherein the insulating film of the piezoelectric thin film resonators forming the receiving filter comprises two layers comprising an  $\text{SiO}_2$  layer adjacent to the piezoelectric thin film and an  $\text{Al}_2\text{O}_3$  layer adjacent to the  $\text{SiO}_2$  layer.

11. The branching filter according to claim 8, wherein the insulating film of the piezoelectric thin film resonators forming the receiving filter comprises two layers comprising an  $\text{SiO}_2$  layer adjacent to the piezoelectric thin film and an AlN layer adjacent to the  $\text{SiO}_2$  layer.

12. The branching filter according to claim 8, wherein the insulating film of the piezoelectric thin film resonators forming the transmitting filter comprises two layers comprising an AlN layer adjacent to the piezoelectric thin film and an  $\text{SiO}_2$  layer adjacent to the AlN layer.

13. The branching filter according to claim 8, wherein the insulating film of the piezoelectric thin film resonators forming the transmitting filter comprises two layers comprising an  $\text{Al}_2\text{O}_3$  layer adjacent to the piezoelectric thin film and an  $\text{SiO}_2$  layer adjacent to the  $\text{Al}_2\text{O}_3$  layer.

14. A communication device comprising the branching filter according to any one of claims 1 to 13.